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Assistant Commissioner for Patents
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Sir:

As authorized by the inventor(s), transmitted herewith for filing
is a patent application applied for on behalf of the inventor(s)
according to the provisions of 37 CFR 1.41(c).

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KANG, Ki Won

For: METHOD FOR RECORDING SEARCH INFORMATION AND SEARCHING FOR
RECORDED DIGITAL DATA STREAMS USING THE SEARCH INFORMATION

Enclosed are:

- X A specification consisting of 17 pages
- X 5 sheet(s) of Formal drawings
- Certified copy of Priority Document(s)
- X Executed Declaration in accordance with 37 CFR 1.64 will follow
- A verified statement to establish small entity status under 37
CFR 1.9 and 37 CFR 1.27
- Preliminary Amendment
- X Information Sheet
- Information Disclosure Statement, PTO-1449 with reference(s)

MAIL ADDRESS: P.O. BOX 747, FALLS CHURCH, VIRGINIA, USA 22040-0747

Other _____

The filing fee has been calculated as shown below:

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X The application transmitted herewith is filed in accordance with 37 CFR 1.41(c). The undersigned has been authorized by the inventor(s) to file the present application. The original duly executed patent application together with the surcharge will be forwarded in due course.

X A check in the amount of \$ 1072.00 to cover the filing fee and recording fee (if applicable) is enclosed.

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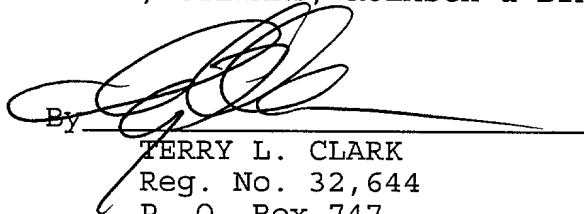
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Respectfully submitted,

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METHOD AND APPARATUS FOR RECORDING SEARCH INFORMATION AND SEARCHING FOR RECORDED DIGITAL DATA STREAMS USING THE SEARCH INFORMATION

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to method and apparatus for creating search information for searching digital data streams recorded on a recording medium and relates to method and apparatus for searching for requested data using
10 the search information.

2. Description of the Related Art

In the conventional analog television broadcast, video signals are transmitted over the air or through cables after being AM or FM modulated. With the recent
15 advance of digital technologies such as digital image compression or digital modulation/demodulation, standardization for digital television broadcast is in rapid progress. Based upon the Moving Picture Experts Group (MPEG) format, satellite and cable broadcast industry also
20 moves towards the digital broadcast.

The digital broadcast offers several advantages that its analog counterpart cannot provide. For example, the

digital broadcast is capable of providing services with far more improved video/audio quality, transmitting several different programs within a fixed bandwidth, and offering enhanced compatibility with digital communication media or
5 digital storage media.

In the digital broadcast, a plurality of programs encoded based upon the MPEG format are multiplexed into a single transport stream before transmitted. The transmitted transport stream is received by a set top box at the
10 receiver and demultiplexed into original programs. If a program is chosen from among the demultiplexed programs, the chosen program is decoded by a decoder in the set top box and original audio and video signals are retrieved. The retrieved audio and video signals can be presented by an
15 A/V output apparatus such as a TV.

It is also possible to record the received digital broadcast signals on a storage medium instead of directly outputting the received broadcast signals to A/V output devices. The stored digital broadcast signals can be edited
20 and retrieved afterwards. For example, a digital data stream received by the set top box can be transmitted to a streamer such as a digital video disk (DVD) recording apparatus through communication interfaces like an IEEE-1394 serial bus and stored in the streamer. The stored
25 digital data stream can be edited and transmitted back to the set top box so that the digital audio and video data can be presented.

For recording a received digital broadcast stream on a recording medium, it is necessary to develop schemes to
30 organize the digital data stream on the recording medium and to create management information for rapid access to the recorded data stream.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method for recording received digital data streams on a recording medium as groups of stream objects and creating search information for each stream object and a method for searching for requested data using the search information.

The method for creating and recording search information for recorded digital data streams in accordance with the present invention comprises the steps of recording a received digital data stream by grouping the received digital data stream into stream object units, creating and recording time information for each stream object unit, and creating and recording index information for pointing to the location on the time information for each stream object as management information for the stream object. When reproducing or editing the recorded digital data streams, the data recording position corresponding to a requested search time can be found with reference to the index information.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention, illustrate the preferred embodiments of the invention, and together with the description, serve to explain the principles of the present invention.

In the drawings:

FIG. 1 is a block diagram of an apparatus in which the present invention may be advantageously employed;

FIG. 2 is the syntax of the management information created by the method for creating search information for recorded digital data streams in accordance with the present invention;

FIG. 3 is a pictorial representation of the stream time map information as a part of the management information created by the method for creating search information for recorded digital data streams in accordance with the present invention;

FIG. 4 is a pictorial representation for explaining the digital data stream recording operation in accordance with the present invention; and

FIG. 5 is a pictorial representation for explaining the management information created by the method for creating search information for recorded digital data streams in accordance with the present invention;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

FIG. 1 depicts a block diagram of an apparatus in which the present invention may be advantageously employed. The apparatus comprises a set top box 100, a communication interface (IEEE-1394), and a streamer 200.

The set top box 100 receives transport streams encoded by system encoders and broadcast by a plurality of broadcasting stations and demultiplexes the received transport streams. After a system decoder 120 decodes the transport stream of a program tuned by a tuning unit 110, a control unit 140 outputs the decoded transport stream to an A/V output device such as a TV set for presentation.

The set top box 100 may transmit a program chosen by a user to the streamer 200 through the IEEE-1394 interface so that the transmitted program is recorded on a recording medium 230 such as a digital video disk by the streamer 200.

Requested by a user, the set top box 100 may receive

a program retrieved from the recording medium 230 by the streamer 200 through the IEEE-1394 communication interface so that the received program can be presented on a TV set after being decoded by the decoder 120.

5 For carrying out these tasks, the set top box 100 and the streamer 200 should be able to access the management information regarding the programs recorded on the recording medium 230. To this end, information files are used to deal with the recorded data. An application

10 information file is utilized by the set top box 100 and a streamer information file is utilized by the streamer 200. A common information file is utilized by both the set top box 100 and the streamer 200. These information files are recorded on the recording medium 230.

15 The application information file is retrieved by a stream reproducing unit 240 of the streamer 200 when the set top box 100 is initialized or requests the file. The retrieved application information is transmitted to the set top box 100 through the IEEE-1394 communication interface
20 and loaded into the management information area M2 of a memory 150 by a control unit 140 of the set top box 100.

When a new program is recorded or recorded data is edited, the application information loaded in the memory 150 is updated by the control unit 140 to include management

25 information on the newly recorded or edited program. If a user requests retrieval of a specific program, the control unit 140 requests the streamer 200 to retrieve the program, with reference to the application information. When the set top box 100 terminates a recording mode or is shut down,

30 the application information in the memory 150 is transmitted through the IEEE-1394 communication interface to the streamer 200 and recorded on the recording medium 230 by a stream recording unit 220 controlled by a control

unit 250 of the streamer 200.

The streamer information file and common information file are retrieved by the stream reproducing unit 240 of the streamer 200 when the streamer 200 is initialized and loaded into a memory 260 by the control unit 250 of the streamer 200. When a new program is recorded or recorded data is edited, the streamer and common information is updated to include management information on the newly recorded or edited program by the control unit 250. If a user requests retrieval of a specific program, the control unit 250 responsive to a request signal from the set top box 100 retrieves the associated program recorded on the recording medium 230 with reference to the streamer and common information loaded in the memory 260. When the set top box 100 terminates a recording mode or is shut down, the streamer and common information in the memory 260 are recorded on the recording medium 230 by the stream recording unit 220 controlled by the control unit 250.

The syntax of the information files and the structure of recorded data will be explained with reference to FIG. 2.

As shown in FIG. 2, the application information file (application.IFO) comprises a table of content (TOC) and a service information (SI) table. The table of content (TOC) contains random-access entry points that allow random access to the recorded data stream and the service information (SI) table contains the information on the recorded digital stream. The common information file (common.IFO) contains an original playlist automatically created when a digital data stream is recorded, presentation sequence information (Cell) of the recorded data stream, and a user-defined playlist created when a user edits the presentation sequence of the recorded data stream.

The streamer information file (streamer.IFO) is intended to deal with stream time map general information (STMAP_GI) and a mapping list (MAPL). The stream time map general information (STMAP_GI) is management information regarding stream object units (SOBUs) organized on the recording medium and stream objects (SOBs) each of which comprises a plurality of stream object units (SOBUs) and the mapping list (MAPL) is time search information regarding the stream object units (SOBUs) and stream objects (SOBs). Each stream object (SOB) has a one-to-one correspondence with each Cell contained in the original playlist and each Cell is contained in the user-defined playlist and has a one-to-one correspondence with each stream object (SOB).

The stream time map general information (STMAP_GI), as shown in FIG. 3, comprises several fields representing the stream object unit size (MAPU_SZ), the weight of the LSB of the mapping list entries (MTU_SHFT), index number (INDEX_NO) indicating an arbitrary entry of the mapping list (MAPL), the number of mapping list entries (MAPL_ENT_Ns), start packet arrival time (S_SAPAT), and last packet arrival time (S_E_APAT). The mapping list (MAPL) comprises mapping entries (MAPU_ENT), each mapping entry containing the incremental application packet time (IAPAT).

The method for creating and recording search information for recorded digital data streams in accordance with an embodiment of the present invention will be explained with reference to FIGS. 1, 2, and 3. If a user asks for recording a received digital data stream on the recording medium 230, the control unit 140 of the set top box 100 notifies the control unit 250 of the streamer 200 that a recording mode has been set and begins to transmit

the received digital data stream to the streamer 200 through the IEEE-1394 interface. Concurrently, the control unit 140 of the set top box 100 records the entry point information that allows random access to the transport stream packets of the digital data stream in the application information (application.IFO) loaded in the management information area (M2) of the memory 150 or records the entry point information in the common information (common.IFO) as a part of the playlist. Also, the control unit 140 detects the information on the data stream currently being recorded from the program service information (SI) loaded in the program information area (M1) of the memory 150 and records the service information in the service information (SI) table of the application information (application.IFO).

The control unit 250 of the streamer 200 controls the stream recording unit 220 so that the data stream received through the IEEE-1394 communication interface is recorded on the recording medium 230. The data stream is organized in sectors on the recording medium 230 and a predetermined number of sectors constitute a stream object unit (SOBU). Such process is repeated until the recording mode terminates, thereby creating a stream object (SOB) which is a group of data stream recorded by a single recording operation.

The control unit 250 of the streamer 200 creates presentation sequence information (Cell) regarding the created stream object (SOB) and records the Cell in the Cell layer of the common information (common.IFO) as presentation sequence information corresponding to the record (RCD) of the original playlist. For searching for stream object units (SOBUs) constituting the stream object (SOB), the time length of every stream object unit (SOBU)

is sequentially recorded in the mapping list (MAPL), To be more specific, a count value counted at a constant time interval while a stream object unit (SOBU) is created, namely, the incremental application packet time (IAPAT) is recorded in the mapping entry field (MAPU_ENT) corresponding to the associated stream object unit (SOBU), as shown in FIGS. 4 and 5. In addition, the sum of a predetermined number of incremental application packet times (IAPATs) (the numbers parenthesized in FIG. 5) is calculated and the sum is recorded as a coarse mapping entry (C_MAP_ENT) which is coarse search time information.

The index number (INDEX_NO) of the first mapping entry (MAPU_ENT) of the mapping list (MAPL) or the first coarse mapping entry (C_MAPU_ENT) associated with the stream object (SOB) is recorded in the stream time map general information (STMAP_GI). In FIG. 5, the index number K of the first mapping entry related to the stream object SOB #n is recorded as identification information for indexing the location of the stream object SOB #n.

If a user requests retrieval of a certain interval of a data stream recorded on the recording medium, for example recorded data corresponding to the time interval from 10 minutes to 20 minutes, the control unit 150 of the streamer 200 first searches Cells for a Cell (Cell 2 in FIG. 2) having a recording time corresponding to the start time 10 minutes. Then, the control unit 150 detects the index number pointing to the start position of the stream object SOB 2 corresponding to the chosen Cell 2 from the stream time map general information (STMAP_GI). Subsequently, the control unit 150 begins to detect the incremental application packet times (IAPATs), starting from the mapping entry pointed to by the index number. By summing the detected incremental application packet times (IAPATs)

and multiplying the sum value by the unit time of each
count, the start position of the stream object unit (SOBU)
corresponding to the requested search time 10 minutes can
be found. Finally, data retrieval begins from the transport
5 stream packet whose packet arrival time coincides with the
requested time.

If a user requests retrieval of the recorded data
corresponding to the time interval from 40 minutes to 60
minutes and the Cell having a recording time corresponding
10 to the requested time 40 minutes is Cell 3, the control
unit 150 detects the index number pointing to the start
position of the stream object SOB 3 corresponding to the
chosen Cell 3 from the stream time map general information
(STMAP_GI). Subsequently, the control unit 150 begins to
15 detect the incremental application packet times (IAPATs)
listed in the mapping list MAPL 3. By summing the detected
incremental application packet times (IAPATs) and
multiplying the sum value by the unit time of each count,
the start position of the stream object unit (SOBU)
20 corresponding to the requested time 40 minutes can be found.
Finally, data retrieval begins from the transport stream
packet whose packet arrival time coincides with the
requested time.

The method for creating and recording search
25 information for recorded digital data streams of the
present invention enables rapid and precise search of a
specific interval of the recorded digital data, provided
that the digital data streams are recorded on a recording
medium as groups of stream objects.

30 The invention may be embodied in other specific forms
without departing from the spirit or essential
characteristics thereof. The present embodiments are
therefore to be considered in all respects as illustrative

and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are
5 therefore intended to be embraced therein.

What is claimed is:

1. A method for creating and recording search information for recorded digital data streams, comprising the steps of:

10 recording a received digital data stream by grouping the received digital data stream into stream object units, with each stream object unit having a predetermined length; creating and recording time information for said each stream object unit, the time information being used to

15 search for said stream object units; and

creating and recording index information for pointing to the location on the time information for each stream object as management information for stream objects, each stream object consisting of a predetermined number of
20 stream object units.

2. A method set forth in claim 1, wherein said time information is the length of each stream object unit, expressed in terms of a count value counted at a constant interval.

25 3. A method set forth in claim 2, wherein said count value is a number incremented by 1 every the constant interval.

4. A method set forth in claim 1, wherein said index information is the order on said time information of a time
30 information entry related to each stream object.

5. A method set forth in claim 4, wherein said index information is the order on said time information of a time information entry corresponding to a first stream object

unit of each stream object.

6. A method for creating and recording search information for recorded digital data streams, comprising the steps of:

5 recording time information on the count value counted at a constant interval for each stream object unit, with each stream object unit consisting of transport streams; and

10 recording index information for pointing to the location on said time information for the start position of each stream object, each stream object consisting of one or more stream object units.

15 7. A method set forth in claim 6, wherein said count value is a number incremented by 1 every the constant interval for a stream object unit.

8. A method set forth in claim 6, wherein said index information is the order on said time information of a time information entry related to each stream object.

20 9. A method set forth in claim 8, wherein said index information is the order on said time information of a time information entry corresponding to a first stream object unit of each stream object.

10. A method for searching recorded digital data streams, comprising the steps of:

25 (a) reading search time information for stream object units, each stream object unit consisting of a plurality of digital transport streams and the search time information being the length of each stream object unit, expressed in terms of a count value counted at a constant interval;

30 (b) detecting a stream object containing a requested search time by comparing the requested search time with start time information of each stream object consisting of a predetermined number of stream object units, the start

time information having been recorded for accessing the stream objects;

(c) reading index information pointing to location on the search time information for a start position of the
5 detected stream object; and

(d) accessing a time information entry corresponding to said read index information.

11. A method set forth in claim 10, further comprising the step (e) of accumulating search time from
10 the accessed time information entry to a time information entry corresponding to the stream object unit containing the requested search time.

12. A method set forth in claim 11, wherein said step (e) compares the accumulated search time with the requested
15 search time and determines the position corresponding to the requested search time based upon the comparison result.

13. A method set forth in claim 12, further comprising the step (f) of reproducing the recorded digital data stream from the determined position.

20 14. A method set forth in claim 10, wherein said index information is the order on said search time information of a first time information entry corresponding to the detected stream object.

15. An apparatus for creating and recording search
25 information for recorded digital data streams, comprising:

recording means for recording a received digital data stream by grouping the received digital data stream into stream object units and for creating and recording time information for each stream object unit for searching for
30 the recorded stream object units, with each stream object unit having a predetermined length; and

control means for creating index information for pointing to the location on the time information for each

stream object as management information for the stream object and controlling said recording means to record said index information, each stream object consisting of one or more stream object units.

5 16. An apparatus set forth in claim 15, wherein said time information is the length of each stream object unit, expressed in terms of a count value counted at a constant interval.

10 17. An apparatus set forth in claim 15, wherein said index information is the order on said time information of a time information entry corresponding to a first stream object unit of each stream object.

18. An apparatus for reproducing recorded digital data streams, comprising:

15 reading means for reading search time information for stream object units, each stream object unit consisting of a plurality of digital transport streams and the search time information being the length of each stream object unit expressed in terms of a count value counted at a
20 constant interval; and

control means for detecting a stream object containing a requested search time by comparing the requested search time with start time of each stream object consisting of one or more stream object units, and
25 controlling said reading means to read the index information pointing to the location on the search time information for the start position of the detected stream object, and moving the data reproducing position of said reading means to access a time information entry
30 corresponding to said read index information, wherein information on the start time of each stream object has been recorded for accessing stream objects.

19. An apparatus for creating and recording search

information for recorded digital data streams, comprising:

a data formatter to group a received digital data stream into stream object units and to create time information for each stream object unit for searching for the stream object units individually, wherein each stream object unit has a predetermined length;

a data recorder to record the digital data stream grouped by and the time information created by said data formatter; and

10 a controller to create index information for pointing to the location on time information created by said data formatter as management information for the stream object and to control said data recorder to record the created index information, wherein each stream object consists of
15 one or more stream object units.

20. An apparatus for reproducing recorded digital data streams, comprising:

a pickup to read recorded stream object units and search time information for the stream object units, each
20 stream object unit consisting of a plurality of digital transport streams and the search time information being the length of each stream object unit expressed in terms of a count value counted at a constant interval;

a data analyzer to detect a stream object read by
25 said pickup containing a requested search time by comparing the requested search time with start time of each stream object consisting of one or more stream object units; and

a controller to control said pickup to read the index information pointing to the location on the search time
30 information read by said pickup for the start position of the stream object detected by said data analyzer, and to move the data reproducing position of said pickup to access a time information entry corresponding to the index

information read by said pickup, wherein information on the start time of each stream object has been recorded for accessing stream objects.

ABSTRACT OF DISCLOSURE

A method for creating and recording management information for searching recorded digital data streams. When a digital data stream is recorded on a recording medium, index information for pointing to the location of the time information corresponding to the first stream object unit of each stream object on a time information table is created and recorded. When reproducing or searching the recorded digital data stream, a stream object is found using the time information of stream objects and the recording location corresponding to a requested search time is found using the index information.

FIG. 1

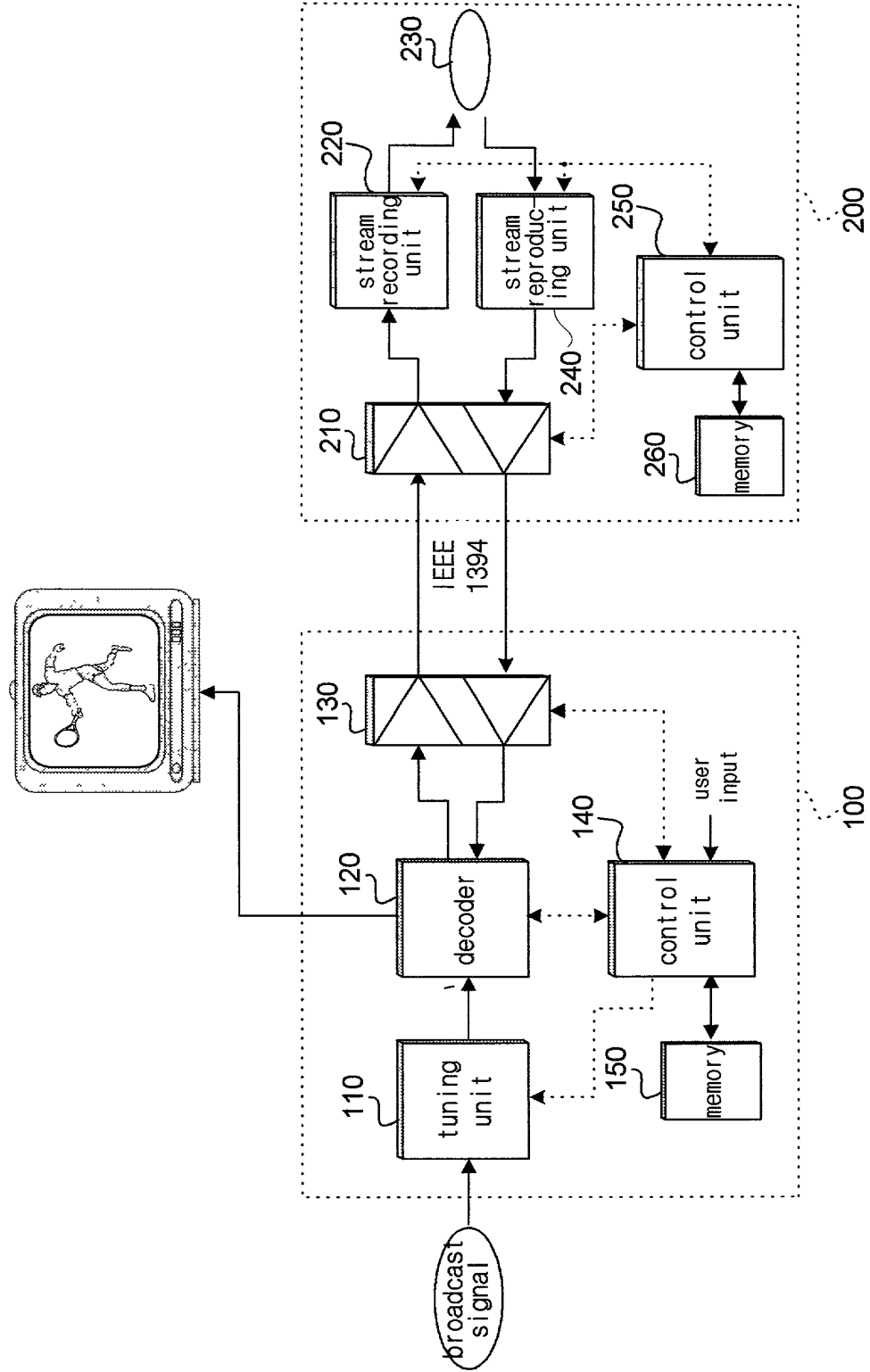


FIG. 3

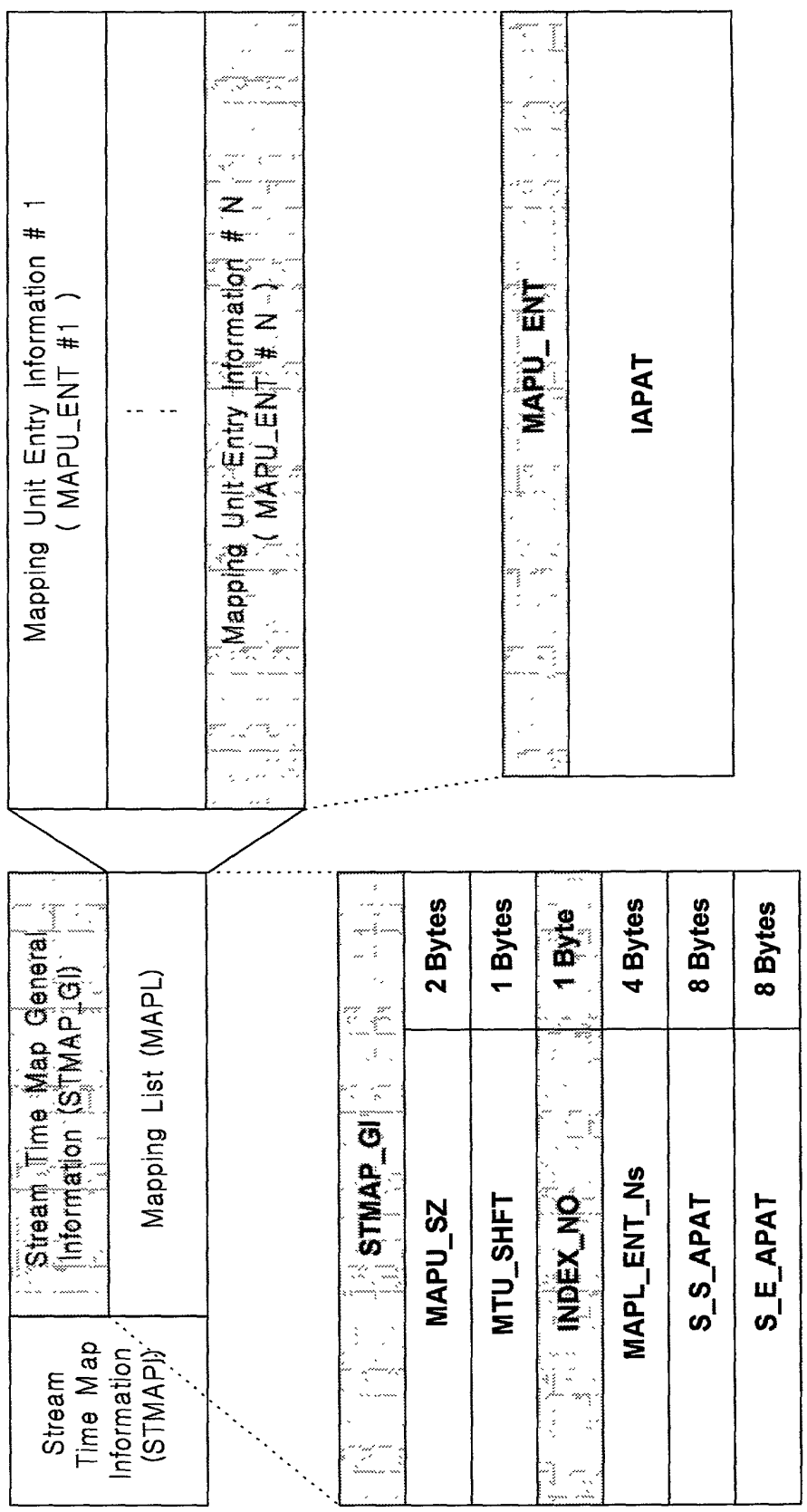


FIG. 4

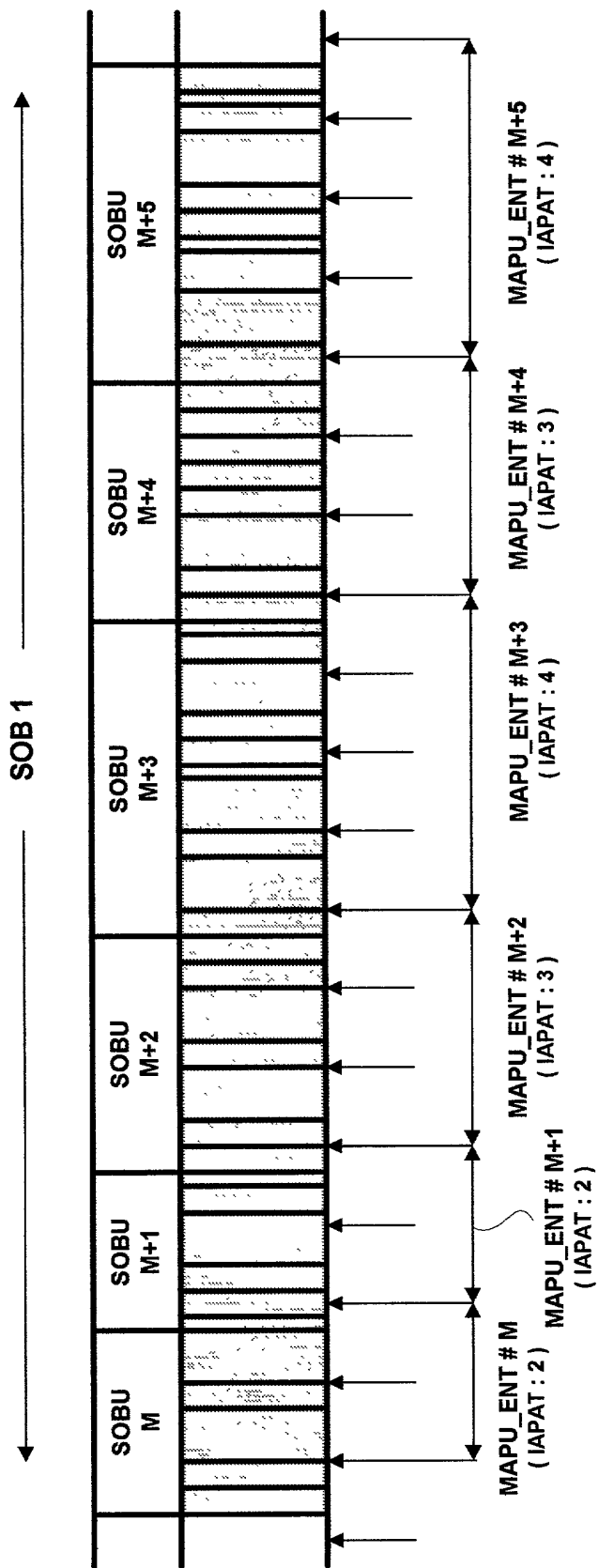


FIG. 5

